Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems

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ABSTRACT

This standard test method provides descriptions of the measurement techniques and cautionary measures most commonly used on underground and submerged piping other than offshore piping to determine whether a specific criterion has been met at a test site. This standard contains instrumentation and general measurement guidelines. It includes methods for voltage drop considerations when structure-to-electrolyte potential measurements are made and provides guidance to minimize incorrect data from being collected and used. This standard is maintained by Task Group 020.

KEYWORDS

pipelines, test methods, underground piping, submerged piping

Foreword

In NACE standards, the terms "shall," "must," "should," and "may" are used in accordance with the definitions of these terms in the NACE Publications Style Manual. The terms "shall" and "must" are used to state a requirement, and are considered mandatory. The term "should" is used to state something good and is recommended, but is not considered mandatory. The term "may" is used to state something considered optional.

This NACE International standard test method provides descriptions of the measurement techniques and cautionary measures most commonly used on underground and submerged piping other than offshore piping to determine whether one or more selected criterion has been met at a representative test site(s) with consideration for special conditions. These methods are also applicable to many other underground or submerged metallic structures. Descriptions of measurement techniques and cautionary measures used on offshore pipelines and structures can be found in NACE SP0115/ISO 15589-2 for offshore pipelines and SP0176 for offshore structures.[1,2] This standard includes only those measurement techniques that relate to the criteria or special conditions, such as a net protective current and alternating current (AC) corrosion testing.[3] This standard is intended for use by corrosion control personnel concerned with the corrosion of underground or submerged piping systems that transport oil, gas, water, or other fluids.

The measurement techniques described require that the measurements be made in the field. Because the measurements are obtained under widely varying circumstances of field conditions and pipeline design, this standard is not as prescriptive as those NACE standard test methods that use laboratory measurements. Instead, this standard gives the user latitude to make testing decisions in the field based on the technical facts available.

This standard contains instrumentation and general measurement guidelines. It includes methods for voltage drop considerations when structure-to-electrolyte potential measurements are made and provides guidance to minimize incorrect data from being collected and used.

The measurement techniques provided in this standard were compiled from information submitted by committee members and others with expertise on the subject. Variations or other techniques not included may be equally effective. The complexity and diversity of environmental conditions may require the use of other techniques.

Appendix A (mandatory) contains information on the common types, use, and maintenance of reference electrodes. Appendix B (nonmandatory) contains information for direct current (DC) Cell-to-Cell Surface Potential Gradient Surveys. Appendix C (nonmandatory) contains information regarding the use of coupons to evaluate cathodic protection (CP), Appendix D (nonmandatory) contains information regarding Dynamic Stray Current testing, Appendix E (nonmandatory) contains information regarding AC Corrosion testing and Appendix F (nonmandatory) contains information regarding Evaluation of Potentials Considering Adequacy of Current Interruption. As there is ongoing research into the nonmandatory procedures, the tester is advised to keep abreast of any revisions or improvements.

The test methods in this standard were originally prepared by NACE Task Group (TG) T-10A-3, "Test Methods and Measurement Techniques Related to Cathodic Protection Criteria," a component of Unit Committee T-10A, "Cathodic Protection," in 1994. It was reviewed /revised by TG 020, "Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems," which is administered by Specific Technology Group (STG) 35, "Pipelines, Tanks, and Well Casings," and is sponsored by STG 05, "Cathodic/Anodic Protection." It was reaffirmed in 2002 by STG 35 and revised in 2012 and 2018 by TG 020. This standard is issued by NACE under the auspices of STG 35.

NACE International

NACE International Test Method (TM0497-2018)

Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems

Section 1: General

1.1   This standard describes and illustrates testing procedures for measuring potentials that are used to determine whether a CP criterion is achieved at a test site on underground or submerged metallic piping systems.

1.2   The provisions of this standard shall be applied by personnel who have the knowledge and understanding of the fundamentals of cathodic protection of buried and submerged metallic piping systems acquired by education and related practical experience.

1.3   Special conditions in which a given test technique is ineffective or only partially effective sometimes exist. Refer to Paragraphs 5.9 and 6.1. Deviation from this standard may be warranted in specific situations.

Section 2: Definitions[1] and Acronyms

2.1   Definitions

Anode: The electrode of an electrochemical cell at which oxidation occurs. Electrons flow away from the anode in the external circuit. Corrosion usually occurs and metal ions enter the solution at the anode.

Cathode: The electrode of an electrochemical cell at which reduction is the principal reaction. Electrons flow toward the cathode in the external circuit.

Cathodic Polarization: The change of electrode potential in the active (negative) direction caused by current across the electrode/electrolyte interface. See *Polarization*.

Cathodic Protection: A technique to reduce the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

Cathodic Protection Coupon: A metal sample representing the pipeline at the test site, used for cathodic protection testing, and having a chemical composition approximating that of the pipe. The coupon size should be small to avoid excessive current drain on the cathodic protection system.

Close-Interval Potential Survey (CIPS): A series of structure-to-electrolyte direct current (DC) potential measurements performed at regularly spaced intervals for assessing the level of cathodic protection (CP) on pipelines and other buried or submerged metallic structures.

Coating: (1) A liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid protective, decorative, or functional adherent film; (2) (in a more general sense) a thin layer of solid material on a surface that provides improved protective, decorative, or functional properties. Coatings used in conjunction with cathodic protection are electrically isolating materials applied to the surface of the metallic structure that provides an adherent film that isolates the metallic structure from the surrounding electrolyte. The thickness and structure of the coating type vary according to the environment and application parameters.

Conductor: A bare or insulated material suitable for carrying electric current.

Corrosion: The deterioration of a material, usually a metal, that results from a reaction with its environment.

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[1] Definitions in this section reflect common usage among practicing corrosion control personnel and apply specifically to how terms are used in this standard. As much as possible, these definitions are in accord with those in NACE/ASTM G193.[4]

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